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PREVALENCE OF INTERNAL AND EXTERNAL ROOT RESORPTION IN PERMANENT ANTERIOR TEETH USING DIGITAL AND DIGITALIZED PERIAPICAL RADIOGRAPHS

PREVALÊNCIA DE RESORÇÃO RADICULAR INTERNA E EXTERNA EM DENTES ANTERIORES PERMANENTES USANDO RADIOGRAFIAS PERIAPÍRICAS DIGITAIS E DIGITALIZADAS

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ABSTRACT
Objective: This study aimed to evaluate the prevalence of internal and external resorption in periapical digital radiographs in permanent anterior teeth of patients attended in a private clinic of radiology in the city of Recife, Pernambuco, Brazil, in a period of three years. Study Design: A retrospective and observation study design was realized with the aim of observing a presence of events. A total of 4630 radiographs were analyzed from the archives of the clinic. Thus, it was observed the presence of internal and external root resorption and their location in in digital and digitalized periapical radiographs. Results: It was observed more external than internal resorption (99,65%) and the teeth most affected by dental resorptions were the upper incisors (11,8%). The apical and cervical thirds were also involved with the same frequency in internal resorption while the apical third was the most involved in external resorption. Conclusion: Digital radiograph has an important and essential paper in correct diagnosis of root resorption and to conduct a correct endodontic treatment.

KEYWORDS: Tooth resorption. Epidemiology. Digital dental radiography. Endodontics.

RESUMO
Objetivo: Este estudo teve como objetivo avaliar a prevalência de reabsorção interna e externa em radiografias digitais periapicais em dentes anteriores permanentes de pacientes atendidos em uma clínica privada de radiologia, durante três anos, na cidade de Recife, Pernambuco, Brasil. Desenho do estudo: Um desenho de estudo retrospectivo e de observação foi realizado com o objetivo de observar a presença de tais eventos. Um total de 4.630 radiografias foram analisadas nos arquivos da clínica. Assim, observou-se a presença de raízes internas e externas reabsorção e sua localização em radiografias periapicais digitais e digitalizadas. Resultados: Observou-se mais reabsorção externa do que interna (99,65%) e os dentes mais afetados pelas reabsorções dentárias foram os incisivos superiores (11,8%). Os terços apicais e cervicais foram envolvidos com a mesma frequência quando analisados a reabsorção interna enquanto na externa, o apical foi o terço mais envolvido na reabsorção. Conclusão: A radiografia digital tem um papel importante e essencial no diagnóstico correto da reabsorção radicular e na realização de um planejamento endodôntico adequado.

PALAVRAS-CHAVE: Reabsorção dentária. Epidemiologia. Endodontia. Radiografia dentária digital

INTRODUCTION

Root resorption is a dental complication that can lead to tooth extraction. There are many classifications and terms for different types of root resorption. For example, 'apical replacement

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resorption' has been used for apical root resorption following orthodontic treatment [1]. The same pathological process has been included under the category of 'inflammatory root resorption'. In the classical classification of root resorption following traumatic injuries, replacement and inflammatory resorption are related to completely different etiologies and treatment protocols [2].

A fundamental distinction must be made between inflammatory resorption and resorption with ankylosis. In the former, the dental hard tissues (dentin and cementum) are colonized by inflammatory multinucleated giant cells, which initiate the resorption. This occurs along the walls of the root canal (internal resorption) or on the external surface of the root (external resorption). Depending on the duration of the stimulus that had provoked the resorption, these processes may be termed transient or progressive. All forms of resorption share a common precipitant, and they cease as soon as the cause is withdrawn. They are thus reversible or self-limited and demonstrate spontaneous repair [3].

The internal resorption can be called intracanal resorption and also canal root resorption. It is considered as a rare case of resorption, appearing as a typical dystrophy of the pulp which jeopardize the hard tissue of the teeth changing its normal morphology [4]. Its etiology is not quite clarified, however, can be associated with dental traumatism and inflammatory alterations of dental pulp after pulp capping or pulpotomy. It can also happen due to the infection of dental pulp or extreme heat. These annoying facts stimulate the pulp tissue, thus the inflammatory process starts and then some undifferentiated cells of the pulp can convert themselves to osteoclasts or macrophages, which results in dentinal resorption [5].

External resorption is a process that may lead to loss of cementum, dentin and bone. It takes place in both vital and non-vital teeth and is mostly identified during routine radiographic or clinical examination, as the majority of cases are asymptomatic. External resorption may be physiological or pathological, and several investigators have classified it into various categories [6]. Consequently, there is still a lack of uniformity in the literature, which is confusing for the dental practitioner. External root resorption has been found to be an infrequent phenomenon that affects either the apical or cervical region of one or several teeth. It is relatively rare to find idiopathic external resorption associated with cervical areas of the tooth and even more uncommon for the condition to involve multiple teeth [7].

To determine whether the resorption is internal or external, the radiograph is examined for continuity of the lesion with the outline of the root canal walls. If the pulp in the root canal is not involved in the resorption, it is usually possible to see the outline of the root canal though the radiolucency of the external resorptive defect. Most external resorptive lesions are asymmetrical, while internal resorptions are usually symmetrical [8]. Therefore, the present study aimed to evaluate the prevalence of internal and external root resorption in digital and digitalized periapical radiographs.

MATERIALS AND METHODS

A retrospective and observation study design were realized with the aim of observing an presence of events. This study was conducted during one year in Recife, Pernambuco, Brazil. The studied population was selected by spontaneous or referenced demand from a private clinic. Participation in the study required the patient's consent in accordance with the recommendations of the National Health Committee and Brazilian Health Department and was approved by the Research Ethics Committee of this institution by number 0181.0.097.000-09.

A sample of 4645 digital and digitalized periapical radiographs were analyzed related to the period of September of 2009 to September of 2010. The clinical data were collected from the last three years and the patients ranged from 12 to 85 years. The inclusion criteria were periapical radiograph of permanent anterior teeth of upper and lower jaws, complete root formation and radiographs acquired in ortoradial position. The exclusion criteria were periapical radiographs of teeth that have undergone periapical surgery and prosthetic crowns and nucleus.

The periapical radiographs used in this research were obtained from periapical radiographic apparatus, X-ray Timex 70 C (Gnatus, Ribeirão Preto, SP, Brazil) for technical oral health using radiographic positioner, Han-shin (JON, Ribeirão Preto, SP, Brazil), to keep the film parallel to the X-ray machine, reducing distortion by poor horizontal and vertical positioning, standardizing the radiographic method. The kilovoltage (kVp) and milliamperage (mA) were 60 and 10, respectively. The time of exposure to x-rays varied according to the biotype of the patient, the anatomy of the region and patient age, trying to provide a better quality image. The radiographic film was used E-speed Film - Kodak Ektaspeed Plus EP 21 (Eastman Kodak Co., NY, USA), whose processing was performed in an automatic processor Macrotec MX2 (Gyrus ACMI, MN, USA). The digitized film was acquired by capturing the image through the scanner Hewlett Packard Scanjet 4C / T (Hewlett Packard, Vancouver, WA, USA) associated with the program Corel Photo-Paint (Corel Corporation, Ontario, Canada).

For periapical radiography digital x-ray machine, their technical configurations and use of positioners followed the same sequence of acquisition of scanned images. However, the digital storage phosphor, Digora (Soredex Orion Corporation, Helsinki, Finland) - optical plate size 30 x 40 mm was used in the movie Replacing periapical, capturing the image indirectly. This board photo-stimulable phosphor, after being exposed to X-rays, is read by a laser scanner and insights from this reading is transferred to a computer monitor in the form of image.

The images were stored in JPEG (Joint Photographic Experts Group) with 150 dpi resolution and file about 700 kB. The JPEG method is commonly used to compress images. The degree of reduction can be adjusted, which lets you choose the storage size and its commitment to image quality. The Paint program (Microsoft Windows, São Paulo, Brazil) version 6.0, viewed through a monitor (Acer, Manaus, Brazil), flat screen, LCD (liquid crystal display) of 14 inches, setting screen of 1024 X 768 pixels resolution was utilized for observation of digital and scanned images. The

evaluation was performed by only one evaluator, specialist in endodontics. To prevent a possible, disturb of the analysis by eyestrain, ambient light and monitor brightness was reduced, the number of images analyzed per day was limited to about 90 tests, and radiographic interpretation was conducted at different times of day. During the assessment, we used a data collection form prepared by the researcher. Was only allowed to manipulate the brightness and contrast of the image, thus respecting the subjectivity of the evaluator to work with images of varying density.

During the observation of digital images and scanned, the questionnaire was filled in form, being initially put a number on the chart, as the number of patient record on clinical radiology, in order to find it easily in digital files. Then, data related to the tooth as the corresponding number of teeth, and finally data related to disease: identifying the location: cervical, middle, apical and internal root resorption and / or outside. If there was resorption in more than a third root, was considered the third most affected of the disease studied.

In analyzing the data distributions were obtained absolute percentages and statistical measures: mean, median, standard deviation (Descriptive statistical techniques) using the statistical test Chi-square test (statistical inference techniques). Statistical tests were performed with an error margin of 5.0%. The software used for data entry and obtaining statistical calculations was SPSS (Statistical Package for the Social Sciences) version 15.

RESULTS

A total of 4,630 radiographs were acquired containing 1 to 6 digital and digitalized periapical radiographs. A total of 2231 (29.4%) cases of internal or external resorption were found. The external resorption was the most frequent with 2223 (99.6%) radiographs.

Table 1 shows the number of teeth with resorption and the percentages based on total of 2231 teeth with resorption. The teeth 11 and 21 possessed the highest percentage 11.8% and 11.7% respectively.

RECISATEC – REVISTA CIENTÍFICA SAÚDE E TECNOLOGIA
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Table 1. Evaluation of teeth with resorption

Teeth	n	% about total of 2231 teeth with resorption
11	263	11,8
12	195	8,7
13	172	7,7
21	261	11,7
22	190	8,5
23	173	7,8
31	211	9,5
32	167	7,5
33	116	5,2
41	207	9,3
42	166	7,4
43	110	4,9
TOTAL	**2231**	**100,0**

The total number of teeth with resorption most (83.5%) occurred in the apical third, followed by (15.5%) and only the middle third (1.0%) in the cervical third (Table 2).

Table 2 – Site assessment of resorption according to the involved teeth

Teeth	Cervical		Middle Third		Apical		TOTAL	
	n	%	n	%	n	%	n	%
11	3	1,1	25	9,5	235	89,4	263	100,0
12	1	0,5	15	7,7	179	91,8	195	100,0
13	2	1,2	15	8,7	155	90,1	172	100,0
21	2	0,8	25	9,6	234	89,7	261	100,0
22	-	-	18	9,5	172	90,5	190	100,0
23	2	1,2	15	8,7	156	90,2	173	100,0
31	2	0,9	56	26,5	153	72,5	211	100,0
32	2	1,2	41	24,6	124	74,3	167	100,0
33	1	0,9	22	19,0	93	80,2	116	100,0
41	3	1,4	53	25,6	151	72,9	207	100,0
42	3	1,8	41	24,7	122	73,5	166	100,0
43	2	1,8	19	17,3	89	80,9	110	100,0
Total	**23**	**1,0**	**345**	**15,5**	**1863**	**83,5**	**2231**	**100,0**

It was found that 3 cases of internal resorption in cervical unit occurred frequently in teeth 12, 13 and 21: two cases with internal resorption in the middle third one occurred in the tooth and another 11 occurred in the element 31 and 3 cases in apical third one occurred in the tooth 23, one 33 and one tooth in the tooth 42 (Table 3).

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Table 3 – Evaluation of the resorption type according to the involved teeth

Third	Dentes envolvidos	Type of resorption					
		Internal		External		TOTAL	
		N	%	N	%	n	%
• **Cervical**	11	-	-	3	100,0	3	100,0
	12	1	100,0	-	-	1	100,0
	13	1	50,0	1	50,0	2	100,0
	21	1	50,0	1	50,0	2	100,0
	23	-	-	2	100,0	2	100,0
	31	-	-	2	100,0	2	100,0
	32	-	-	2	100,0	2	100,0
	33	-	-	1	100,0	1	100,0
	41	-	-	3	100,0	3	100,0
	42	-	-	3	100,0	3	100,0
	43	-	-	2	100,0	2	100,0
	Total	**3**	**13,0**	**20**	**87,0**	**23**	**100,0**
• **Middle**	11	1	4,0	24	96,0	25	100,0
	12	-	-	15	100,0	15	100,0
	13	-	-	15	100,0	15	100,0
	21	-	-	25	100,0	25	100,0
	22	-	-	18	100,0	18	100,0
	23	-	-	15	100,0	15	100,0
	31	1	1,8	55	98,2	56	100,0
	32	-	-	41	100,0	41	100,0
	33	-	-	22	100,0	22	100,0
	41	-	-	53	100,0	53	100,0
	42	-	-	41	100,0	41	100,0
	43	-	-	19	100,0	19	100,0
	Total	**2**	**0,6**	**343**	**99,4**	**345**	**100,0**
• **Apical**	11	-	-	235	100,0	235	100,0
	12	-	-	179	100,0	179	100,0
	13	-	-	155	100,0	155	100,0
	21	-	-	234	100,0	234	100,0
	22	-	-	172	100,0	172	100,0
	23	1	0,6	155	99,4	156	100,0
	31	-	-	153	100,0	153	100,0
	32	-	-	124	100,0	124	100,0
	33	1	1,1	92	98,9	93	100,0
	41	-	-	151	100,0	151	100,0
	42	1	0,8	121	99,2	122	100,0
	43	-	-	89	100,0	89	100,0
	Total	**3**	**0,2**	**1860**	**99,8**	**1863**	**100,0**

Table 4 analyzed the occurrence of dentinal resorption according to age and sex of the patient. The percentage of patients with resorption increased with age, being 35.9% in the range up to 39 years and 56.8% in the group aged 60 or older and the margin of error considering the association between the two variables shows significant ($p < 0.05$). The percentage of patients with bone

resorption was 4.6% higher in males than in females (47.8% vs. 43.2%) and is not proven association between sex and dentin resorption (p> 0.05).

Table 4 - Assessment of the type of occurrence of root resorption according to age and sex

Variable	Resorption Yes		No		TOTAL		p value
	n	%	N	%	n	%	
• **Age**							
0-39	46	35,9	82	64,1	128	100,0	p (1) = 0,015*
40 a 59	61	50,8	59	49,2	120	100,0	
≥60	25	56,8	19	43,2	44	100,0	
TOTAL	**132**	**45,2**	**160**	**54,8**	**292**	**100,0**	
• **Sex**							
Male	66	47,8	72	52,2	138	100,0	p (1) = 0,247
Female	70	43,2	92	56,8	162	100,0	
TOTAL	**136**	**45,3**	**164**	**54,7**	**300**	**100,0**	

(*): Significative association by 5,0%.
(1): Pearson Chi-square.

DISCUSSION

Data about the prevalence of traumatic injuries are rare in the literature, it is not possible to perform any kind of comparison or establish a clear trend in the worldwide due to the lack of standardized methods for data collection. There are few studies that assess the frequency of internal resorption, and they agree on the fact that this pathology is a relatively rare entity [4, 9, 10]. Our findings agree with the authors, where we found eight cases of internal resorption in teeth with resorption 2231, resulting in a prevalence of about 0.35.

In the majority of the cases, the internal resorption usually is asymptomatic and detectable by routine radiographs [11]. Radiographically is described as a radiolucent area characterized by an oval-shaped enlargement of the root canal, showing many times the appearance of an ampoule, and which does not move with variations of radiographic angle [11, 12, 13]. In more evolved cases, the fragility of the dental structure can cause areas of fracture or perforation.

The location of internal resorption is varied and has a predilection for the cervical region, it can nevertheless be located in any region of the root canal system [4, 12, 13, 14]. Regardless of location, when the internal resorption reaches the outer surface of the root and root integrity is lost, there may be destruction of periodontal tissues adjacent and pulp necrosis [15]. In our results of 8 cases of internal resorption assessed, 3 had pathology in the cervical region, two in the middle third and 3 in the apical region.

Diagnosis of cervical external root resorption is made only rarely, but when present it is a challenge for clinicians. The precise etiology of the cervical resorption is still unknown, and many related factors have been proposed. Except for the systemic and idiopathic form, external cervical

resorption can occur late after orthodontic tooth movement, oral surgery, periodontal root scaling and planing, tooth bleaching, trauma, bruxism, tooth fracture, developmental defects or a combination of these predisposing factors [7]. It has been speculated that it is the result of local damage or alteration of the cervical aspect of the root surface, rendering it susceptible to multinuclear cells with resorptive-clastic activity during an inflammatory response of the periodontal ligament to traumatic or bacterial stimulus [16]. It has also been suggested that the periodontal ligament and cementum may play a preventive role, offering resistance to resorption of the root surface [7]. In addition, it has been shown that damage to the hard tissue barrier can trigger osteoclastic activity, and perhaps a similar phenomenon occurs in the case of resorption defects on the root surface [17].

The treatment of the resorptions is complex, it demands time, is expensive and its prognostic is unpredictable. One of the reasons that make its prognostic difficult is related to the fact that the periapical radiography emphasizes the observation of two dimensions only and the visibility of its length and location is limited [12, 13].

The dental surgeons and specialists in endodontics must know how to diagnose it by simple methods like periapical radiography, which is an easy, available and routine method of the odontological clinic, which can lead the professional to the diagnostic and the follow-up of this pathology [12, 13, 18]. However, it is important to emphasize the restraints of radiographic exams in cases of resorption. This exam allows the visibility of the injury in two dimensions only which makes difficult the choosen of the suitable treatment and many times its diagnostic [19]. Besides that, depending on the degree of evolution of the resorption, this one can show a uniform density and this way does not move itself with variations of radiographic angles, which makes more difficult its correct location. Thus, other methods of analysis are found in the literature as complementary options, which we hope it will be available for the specialist in the future: optic microscopy, electronic scanning microscopy, 3D images and rotational tomography [11, 13, 20, 21]. In this study, periapical radiographic images can be considered strictly tool than compared with modern equipment available today, such as cone beam computed tomography. However, for the reality of Brazil it's a sophisticated equipment with not widespread routine.

Due to the fact that the incisors are the most affected by root resorption lead to the assessment of levels of root resorption in upper central and lateral incisors in this study, and the inclusion of the lower incisors and canines of both jaws. Corroborating the literature [2, 5, 22, 23], the total number of teeth examined had highest frequencies in the incisors with values of 28.7%, 21.3%, 28.5% and 20.8% respectively for right central and lateral and left central and lateral.

The radiographic periapical preservation should be a routine procedure in orthodontic clinic, aiming to prevent and control external apical root resorption. The professionals should do periapical radiographs at the beginning of orthodontic treatment, and range from 6 to 9 months during treatment, and initial detailed interview. Upon the occurrence of resorption, patients should be informed immediately. It has been to be emphasize about the importance of a thorough clinical and

radiographic exam because the more precocious is the diagnostic of the internal root resorptions the more successful can be the prognostic and the treatment. Digital radiograph has an important and essential paper in correct diagnosis of root resorption and to conduct a correct endodontic treatment.

FINAL CONSIDERATIONS

Digital radiograph has an important and essential paper in correct diagnosis of root resorption and to conduct a correct endodontic treatment**.**

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